

DESCRIPTION OF A NEW SPECIES OF *EPIBLEMA*
(LEPIDOPTERA: TORTRICIDAE: OLETHREUTINAE)
FROM COASTAL REDWOOD FORESTS IN
CALIFORNIA WITH AN ANALYSIS OF
THE FOREWING PATTERN

RICHARD L. BROWN¹ AND JERRY A. POWELL²

¹Department of Entomology, Drawer EM, Mississippi State, Mississippi 39762;

²Department of Entomological Sciences, University of California,
Berkeley, California 94720

Abstract.—*Epiblema deverrae* R. Brown, NEW SPECIES, is described from Monterey and Sonoma Counties, California and is differentiated from the sympatric species, *E. hirsutana* (Walsingham) and *E. radicana* (Walsingham), and from similar allopatric species. A description of its forewing pattern is based on an analysis of fasciae, color fields, and strigulae in the Olethreutinae.

Key Words.—Insecta, Tortricidae, Eucosmini, *Epiblema deverrae*, forewing pattern, strigulae, Asteraceae, *Madia*

An inventory of the Lepidoptera at the Landels-Hill Big Creek Reserve, Monterey County, California, has been conducted during the past decade (JAP, unpublished data). This is the first attempt to census the entire fauna of moths and butterflies at any locality in western North America. The Big Creek Reserve, one of 27 areas maintained by the Natural Reserve System (UCNRS) of the University of California, is situated about 30 km southeast of Big Sur, in the Santa Lucia Mountains, which end abruptly at the Pacific coast. The reserve encompasses 1550 ha, rising from sea level to 1200 m elevation (900 m in the areas surveyed). Rugged coastal mountains rise abruptly from the shoreline and are dominated by narrow ridges separated by deep, V-shaped canyons with walls that rise steeply from narrow streamside terraces. Vegetation types include coastal scrub, California sage scrub, *Ceanothus* and chamise chaparral, redwood forest, mixed hardwood forest, ponderosa pine-manzanita woodland, and sparse chaparral on rocky montane ridges (buckwheat [*Eriogonum*], yerba santa [*Eriodictyon*], and *Yucca whipplei* Torrey).

The reserve has been surveyed on more than 80 dates, using three approaches: diurnal net collecting, larval sampling and rearing, and blacklight attraction at sheets and traps. To date about 650 species have been differentiated, of which 26% are represented by larval collections. Based on comparisons with the numbers of flowering species (326) (Bickford & Rich 1984), as well as butterflies at Big Creek (57), and macro moths known at other stations in coastal California (McFarland 1965; Opler & Buckett 1971; JAP, unpublished data), a census of 800–850 species of Lepidoptera at Big Creek is anticipated.

The survey has yielded several species of moths that were previously unknown in the central coast ranges and at least three undescribed species of microlepidoptera in better studied families (Momphidae, Tortricidae), including a distinctive new

species of *Epiblema*. The genus *Epiblema* includes more than 100 species in the Holarctic region and southern Asia. Of these, 39 occur in America, north of Mexico (Blanchard 1979, 1985; Powell 1983; Miller 1985). *Epiblema* appears to be related to *Eucosma*, *Pelochrista*, *Sonia*, and other eucosmine genera that include species with larvae boring in stems and roots of Asteraceae. The description of this new *Epiblema* is facilitated with selected information from a recent analysis of forewing patterns in Tortricidae (RLB, unpublished data).

METHODS AND MATERIALS

A stereomicroscope with an ocular micrometer was used to examine and measure specimens. Specimens of all species mentioned in the diagnosis were examined except *E. simploniana* (Duponchel), of which figures were examined. The forewing length was measured from base to apex, including the fringe. Cornuti of the aedeagus were counted by examination of their sockets with a compound microscope. Valval length was measured as a straight line from the ventral, proximal corner of the sacculus to the apex of the cucullus. Colors were described with the standards of Kornerup & Wanscher (1983). The forewing description is based on a comparative study of pattern elements in more than 600 tortricid species representing all tribes defined by Horak & Brown (in press). The following abbreviations are used for depositories: Mississippi Entomological Museum, Mississippi State University (MEM); University of California, Berkeley (UCB).

FOREWING PATTERN ELEMENTS IN *EPIBLEMA*

Nijhout (1978) provided the following terminology for the five major types of pattern elements on Lepidoptera wings, as described by Süffert (1929): ripple patterns, dependent patterns, crossbands (fasciae), eyespots (ocelli), and color fields. These types, except ripple patterns, are present in *Epiblema*, including the species described here.

Fasciae occur on ontogenetically determined areas of the wing (Nijhout 1978, 1990) and generally are more darkly pigmented than the surrounding ground color. The areas between fasciae here are termed interfascial areas. The distinctiveness of fasciae is dependent on both the number of scales that are darkly pigmented (degree of expression) and the degree to which dark pigment is lacking in the interfascial areas. Based on an analysis of forewing patterns in the Tortricidae, the ancestral pattern is interpreted to include six fasciae: basal, subbasal, medial, postmedial, subterminal, and terminal. These fasciae, except for the terminal, previously have been identified in the tortricine tribe Cochylini (Bradley et al. 1973). In the Olethreutinae, the basal and subbasal fasciae are often confluent to form a basal patch; the median fascia usually is well expressed, although often broken near CuA₂ to form a separate pretornal spot; the postmedian fascia (termed the preapical fascia by some authors) is expressed usually as one or more spots, the largest and most anterior being the postmedian spot (termed the preapical spot by some authors); and the subterminal and terminal fasciae are either not expressed or are represented by narrow umbrae or small spots (Fig. 1).

Color fields have been defined as large areas of the wing surface that contrast in coloration with other areas and are not a fascia or other pattern element (Nijhout 1978). Süffert (1929) and Nijhout (1978) noted that "color fields" represented a lumping of more than one type of pattern element, and that little effort had been

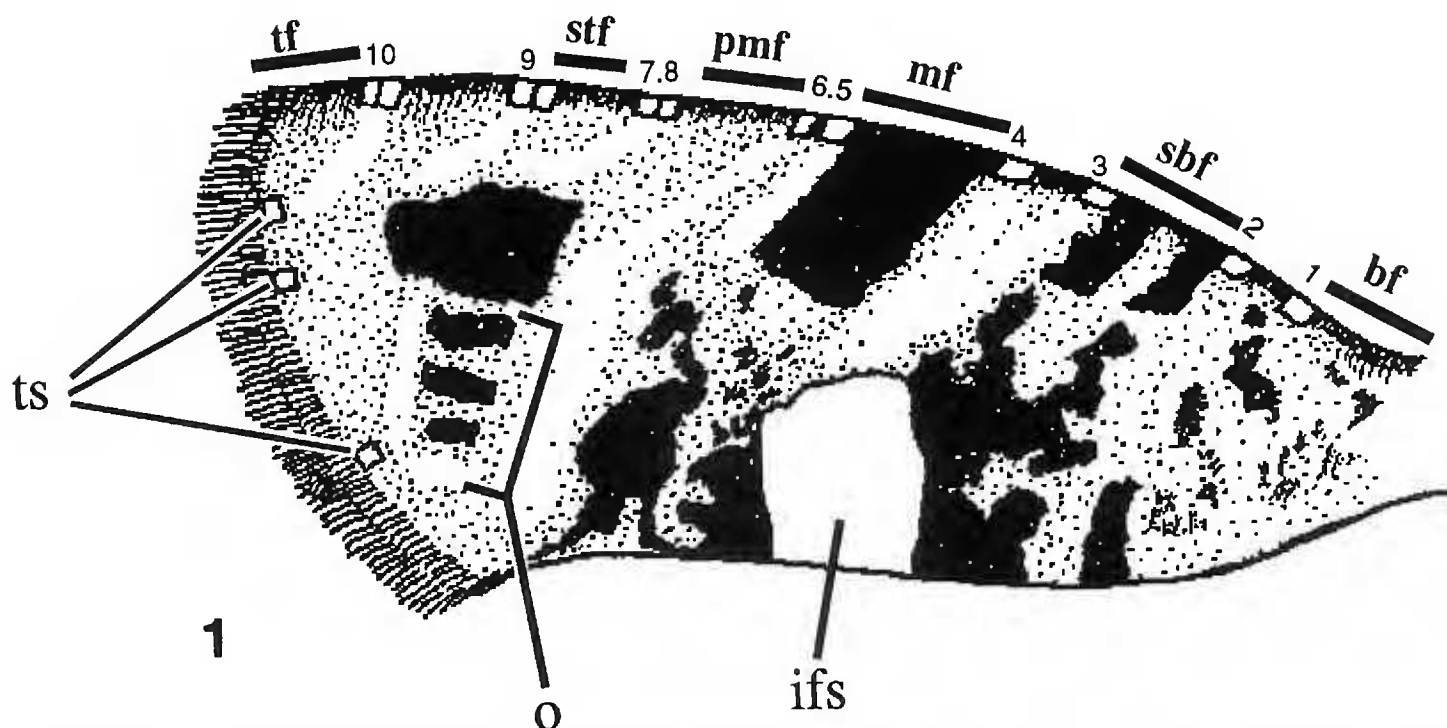


Figure 1. *Epiblema deverrae*, forewing pattern indicating positions of expressed and nonexpressed fasciae relative to coastal strigulae 1–10. ifs—interfascial spot, mf—median fascia, o—ocellus, pmf—postmedian fascia, sbf—subbasal fascia, stf—subterminal fascia, tf—terminal fascia, ts—terminal strigulae.

made in the analysis of the various types of color fields. Two types of color fields commonly occur in the Tortricidae, and here these are termed “patches” and “spots.” The term patch is used to describe a color field that differs from the ground color and that covers at least one fascia and one interfascial area. Although patches include several subgroups, depending on their position and size, patches often involve the expression of fasciae only on the costal or inner margins of the wing and the intervening interfascial area. The term spot is used for contrasting pigmentation that is confined either to a restricted portion of a fascia (i.e., pretornal spot) or to a restricted portion of an interfascial area (i.e., interfascial spot).

Interfascial spots are present on the inner margin (dorsum) between the subbasal and median fasciae in many species of the Olethreutinae, including the *Epiblema* described here (Fig. 1). Patches are common on the inner margin in generalized genera in the Eucosmini, especially in *Ancylis* and *Epinotia* (e.g., *E. solandriana* (L.)) (Bradley et al. 1979: pl. 32, Figs. 5–8) and on the costa in various unrelated genera (e.g., *Ancylis*, *Pseudexentera* and *Acleris*) (Bradley et al. 1973: pl. 40, Figs. 10–11). Although interfascial spots are present in many species of *Epiblema*, *Eucosma*, and related genera, patches have not been detected in any representative of this derived group of Eucosmini.

Strigulae, or short transverse marks, are present on the costa of most Olethreutinae, some Chlidanotinae, and some generalized Tortricinae (e.g., Phricanthini) (Horak & Brown in press). These strigulae appear to be dependent patterns, as they occur on the inner and outer margins of fasciae. In addition, strigulae apical to R_2 occur between the veins at the wing margin. Danilevski & Kuznetsov (1968) and Kuznetsov (1978) recognized seven pairs of costal strigulae, and these were numbered one to seven from apex to base. Examinations of species in the tribes Gatesclarkeanini, Phricanthini, and Chlidanotini by RLB indicate that the ancestral condition is the presence of ten costal strigulae between the wing base and R_5 ; these are numbered here 1–10 from wing base to apex. Strigulae are not limited

to the forewing costa; among various Tortricidae, a strigula may be present between each pair of adjacent veins on the termen, and here these are termed terminal strigulae.

Each of the costal strigulae in the Olethreutinae has a narrow stria extending towards the inner or outer margin, and these striae, which often are a shade of gray, appear to be silver when viewed through the microscope at an angle to the light. Each of the ten costal strigulae are paired in representatives of primitive taxa, but some are single in derived taxa. In derived taxa, some strigulae (e.g., numbers five and six in the species described here) are approximate or confluent (Fig. 1). Confluence of two independent strigulae to form what appears to be a single or paired strigula usually can be determined by examinations of related species or the detection of two silver striae arising from one apparent strigula.

Süffert (1929), as translated by Nijhout (1978), recognized four classes of ocelli, or eyespots, on Lepidoptera wings. Of these, band ocelli are present in the Olethreutinae, especially in the Grapholitini and derived Eucosmini. These ocelli are formed from the fragmentation of fasciae, usually the postmedian fascia, and the resulting fascial spots are accentuated by the gray striae, often widened, that originate from costal strigulae (Fig. 1).

EPIBLEMA DEVERRAE R. BROWN, NEW SPECIES

Types. — Holotype, male, data: "CALIF: Monterey Co., Landels-Hill Big Creek Res., 5 mi. N. Lucia, 4–6 June 1982; J. Powell, collector"; deposited at the University of California, Berkeley. The holotype is in excellent condition except for missing meso- and metathoracic legs on the right side. Paratypes, deposited as noted in parentheses: USA. CALIFORNIA. *MONTEREY Co.*: same data as holotype, 2 females, 4 males (genitalia slide JAP 5121) (UCB), 1 female (genitalia slide R. L. Brown 1321) (MEM); Big Creek Reserve, UCNLWR, Brunette Creek, 60–180 m el, redwood-hardwood, 26–28 May 1987, J. Powell, 1 female, 3 males (UCB); Big Creek Reserve, UCNLWR, headquarters, coastal to confluence area, 0–60 m, 26–28 May 1987, J. Powell, 1 female (UCB); Big Creek Reserve, UCNLWRS, Brunette Creek, 60–180 m el, redwood-hardwood, 5–8 Jun 1989, Y-F. Hsu and J. Powell, 1 female, 1 male (UCB), 1 male (MEM); Big Creek Reserve, UCNRS, Devils Creek Flat, 120 m el, 7 Jun 1989, J. Powell, 1 male (UCB). *SONOMA Co.*: Cazadero, 6 Jun 1979, J. Powell, 1 female (UCB).

Description. — *Head*: vertex and upper frons brown, brown-orange, or gray-brown, darker brown between antennae in some specimens; labial palpus with basal one-half orange-white or orange-gray, apical one-half brown or light brown. *Mesonotum*: brown to dark brown; tegulae brown to dark brown basally, brown or brown intermixed with gray-orange apically. *Forewing* (Figs. 1, 2): Forewing length 5.3–7.1 mm in males, 5.5–7.0 in females; male costal fold extending from base to proximal margin of median fascia, length of fold 0.33–0.40 forewing length. Upperside ground color brown to gray-brown intermixed with orange, with orange increasing in apical one-half; pattern elements including indistinct, broken, dark brown fasciae, white to orange-white interfascial spot on inner margin, white to orange-white costal strigulae, and white terminal strigulae. Basal and subbasal fasciae not forming distinct basal patch; basal fascia indistinct, basal area with small spots and broken, narrow umbrae; subbasal fascia reduced to broken umbrae, umbrae broad and confluent near midwing and inner margin, distal margin of fascia angled at midwing, extending to costa at about $0.30\times$ the forewing length; median fascia broken by orange or brown near midwing into large spot on costa and large spot on inner margin, some specimens with inner marginal portion of fascia broken by orange or brown into small proximal spot and larger distal spot; postmedian fascia represented by large postmedian spot (appearing as two or three spots in some rubbed specimens) near apex of discal cell and three



Figure 2. *Epiblema deverrae*, female, Sonoma Co., California.

small bars, three bars bordered by subequal, gray (silver when viewed at an angle to the light) spot on inner margin near tornus and by broad, transverse, gray (silver) lines proximally and distally to form ocellus; subterminal fascia indistinct; terminal fascia represented by small spot at wing apex in some specimens. Interfascial spot present between subbasal fascia and median fascia, extending from inner margin to Cu_2 , subquadrate with proximal margin longer than distal margin. Costa with four to six conspicuous strigulae, strigulae one and two confluent with each other or indistinct; strigula three single, marking distal margin of subbasal fascia; strigula four single, marking proximal margin of median fascia, separated from strigula three by small dark brown spot, strigulae three and four indistinct in some specimens, each strigula with a gray (silver) stria extending posteriorly, striae becoming confluent at discal cell and extending to interfascial spot; strigulae five and six approximate at distal margin of median fascia, appearing as a single paired strigula, strigula five with gray (silver) stria extending to midwing, strigula six with gray (silver) stria extending to near tornus, becoming broad at midwing; strigulae seven and eight apparently confluent, appearing as single strigula in some specimens, with single gray (silver) stria extending to proximal margin of postmedian spot; strigula nine single or paired, with gray (silver) stria extending to distal margin of postmedian spot; strigula 10 paired, with strigulae separated by dark brown spot, with gray (silver) stria extending to M_1 at termen; strigulae 5–6, 7–8, 9, and 10 bordered by orange or dark brown, separated from each other by dark brown spots. Termen with small strigulae between R_5 and M_1 , M_1 and M_2 , and CuA_1 and CuA_2 , some specimens with orange-white, attenuate, fringe scales arising from strigulae. Proximal fringe scales attenuate, short, brown with white to orange-white apices; distal fringe scales attenuate, long, gray-brown. Forewing underside brown except white to orange-white costal strigulae and area of hindwing overlap posterior to CuP . *Hindwing*: Upperside uniformly brown except area of forewing overlap anterior to $Sc+R_1$; underside uniformly brown, concolorous with forewing underside. *Male genitalia* (Fig. 3): Uncus reduced to rounded lobe, densely setose dorsally; socii slightly flattened, moderately setose posteriorly; gnathos arising from triangular projections of tegumen; aedeagus with patch of 13 or 14 cornuti on vesica; anellus with pointed anterior ventral corners; valva with sacculus moderately setose, clasper at base near dorsal margin with flat medial surface and beset with group of short, moderately stout setae, a second clasper-like, rounded projection near sacculus with sparse, slender, short to long setae, ventral margin of neck without setae, cucullus large relative to valva, length of cucullus $0.60 \times$ length of valva (one preparation examined). *Female genitalia* (Fig. 4): Sternum VII with moderately dense scales throughout, posterior one-half with sparse, short setae, becoming dense on posterolateral corners; tergum VIII with moderately dense, long setae on posterior fourth and on triangular, lateral extensions, scales absent; papillae anales densely setose, without rugae or papillose projections; lamella postvaginalis with dense microtrichia medially, with sparse, long setae on lateral rims; lamella antevaginalis reduced to lightly sclerotized, smooth rim; ductus bursae weakly spiraled, with moderately sclerotized colliculum posterior to inception of ductus seminalis; signa flat, blade-like, bases with shallow invaginations (one preparation examined).

Diagnosis.—*Epiblema deverrae* is superficially similar to *E. hirsutana* (Walsingham), which was described from Sonoma Co., California. In *E. hirsutana*,

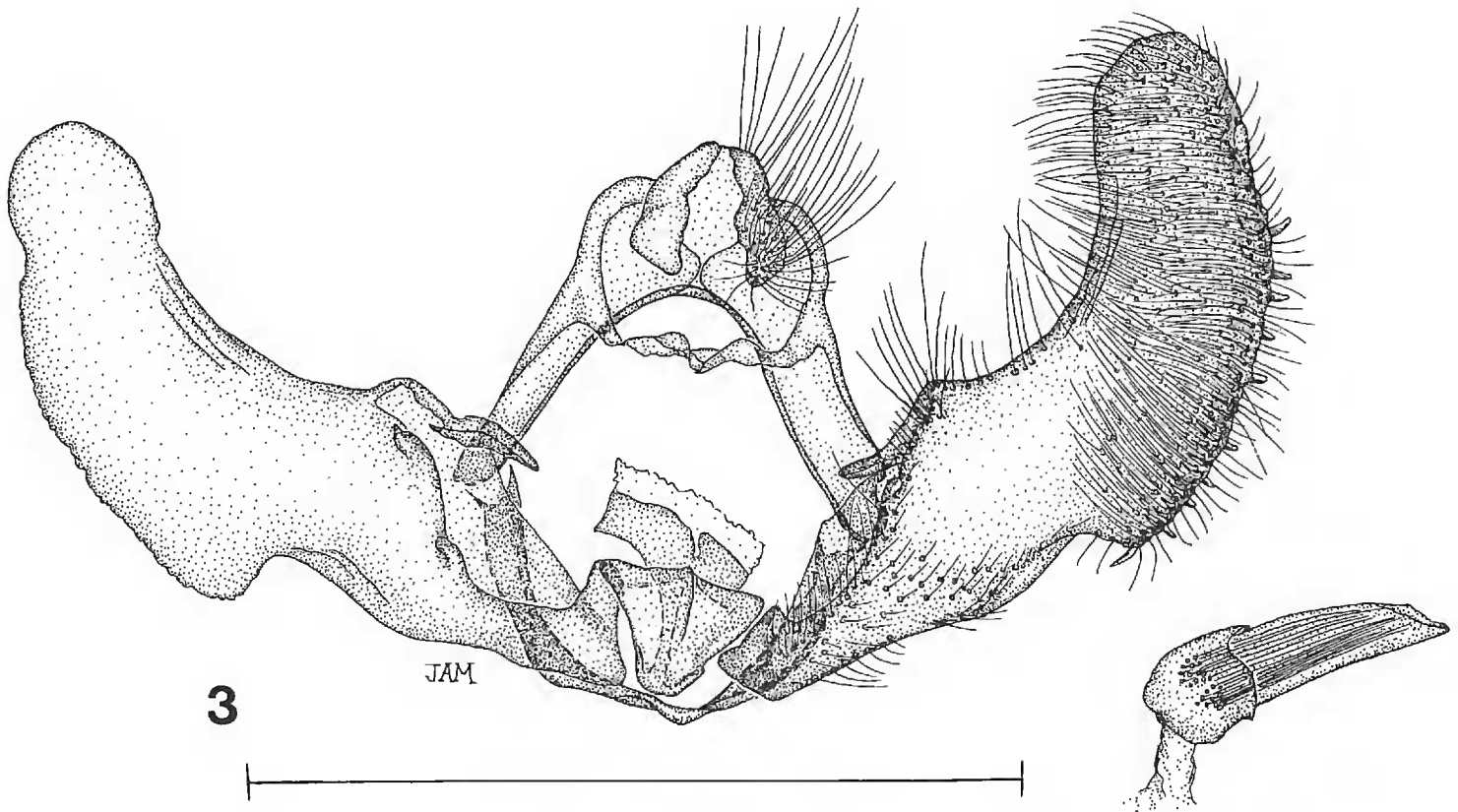


Figure 3. *Epiblema deverrae*, male genitalia with aedeagus detached. Scale line = 0.5 mm.

the head and labial palpi appear bushy due to long, erect, narrow scales, and the forewing lacks a large postmedian spot and a contrasting median fascia. The interfascial white spot is less well defined in *E. hirsutana*, and is not suffused with pale orange. The male genitalia of *E. hirsutana* has a valve with a broader cucullus and a single clasper. The female genitalia of *E. hirsutana* has a longer ductus bursae with a more lightly sclerotized colliculum. *Epiblema radicana* (Walsingham), also occurring in western North America, is a larger species with a forewing lacking an ocellus and having a paler interfascial area between the median fascia and postmedian fascia and with genitalia differing in several characters (Obraztsov 1965: Figs. 1–10). Allopatric species that are superficially similar to *E. deverrae* include *E. walsinghami* (Kearfott) and *E. infelix* (Heinrich), occurring in the eastern United States, *E. arctica* Miller, occurring in Alaska, and *E. graphana* Treitschke, *E. farfarae* Fletcher, *E. simploniana*, and some forms of *E. scutulana* (Denis & Schiffermüller), occurring in the Palearctic region. None of these latter species has a forewing with a large postmedian spot combined with orange scales in the apical area, and all differ in characters of the male genitalia, as figured by Miller (1985, 1987) and Kuznetsov (1978).

Comments. — The new species was discovered in Big Creek Reserve at two sites, about 2 km apart, in 1982: on the upper Brunette Creek trail at about 180 m elevation in the Big Creek drainage, and along the road above Devil's Creek Flat at 120–130 m. Additional individuals were collected in later years, subsequent to an extensive fire that burned both sites in July, 1985. Adults seem to be univoltine and diurnal; all were flying during afternoons and none have appeared at blacklights deployed in various areas of the reserve. They seem to be associated with *Madia madiodes* (Nuttall) (Asteraceae) growing in loose rocky talus in open areas in forests dominated by redwood (*Sequoia sempervirens* (D. Don.)). No gall formations were found on this herbaceous perennial, and we speculate that larvae of *E. deverrae* feed on underground rootstocks.

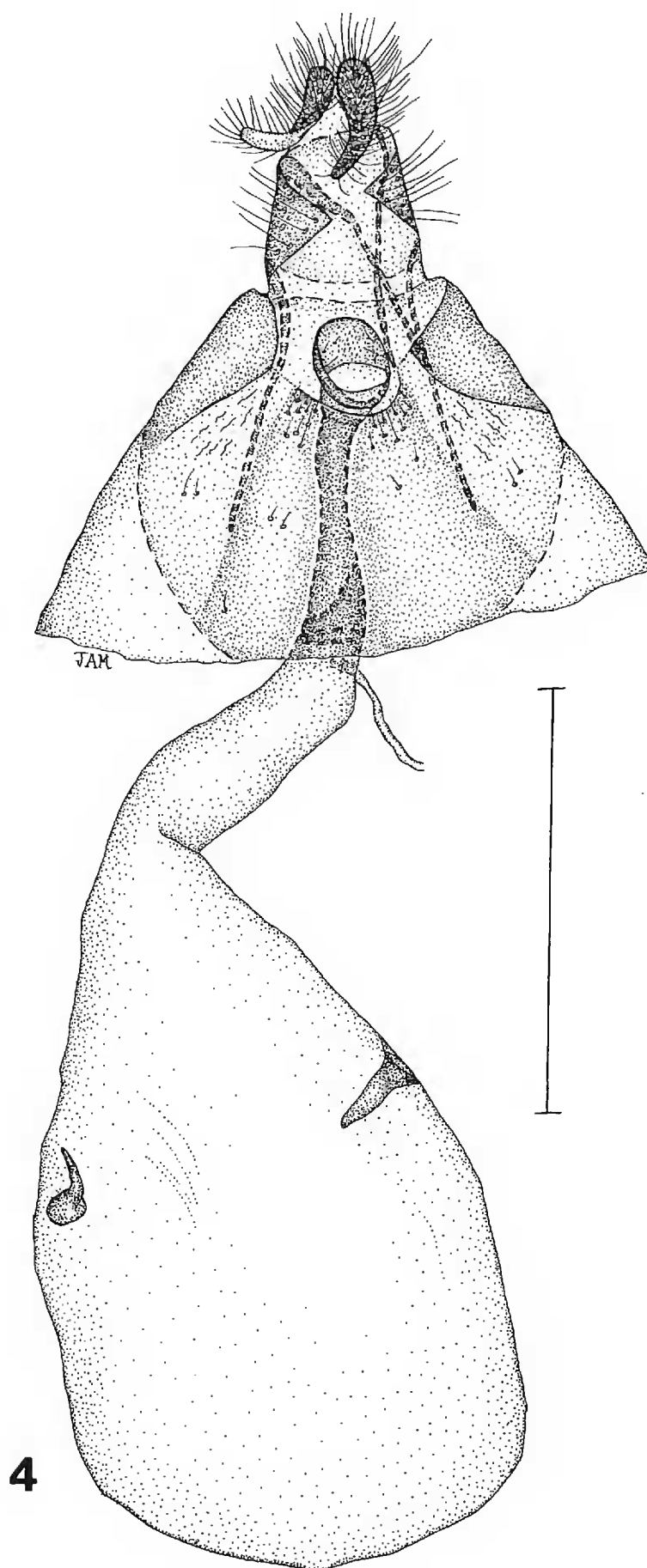


Figure 4. *Epiblema deverrae*, female genitalia. Scale line = 0.5 mm.

Madia madioides ranges from Monterey County, northward, along the Pacific coast, in mixed evergreen and coastal coniferous forests, to Vancouver Island (Munz 1959).

Etymology.—The specific name *deverrae* is formed from Deverra, the Roman goddess of brooms and sweeping.

Material Examined.—See types.

ACKNOWLEDGMENT

We thank K. R. Tuck (British Museum [Natural History]) for comparing *E. deverrae* with the type of *E. hirsutana*, J. A. MacGown for drawing the figures, D. Reed for computer scanning, J. Tisdale for word processing, and S. Cho for photographing the imago. Cooperation by John Smiley (Big Creek Reserve) has facilitated the survey at Big Creek in many ways. The Mississippi Agricultural and Forestry Experiment Station has approved this paper as contribution no. 7607.

LITERATURE CITED

- Bickford, C. & P. Rich. 1984. Vegetation and flora of the Landels-Hill Big Creek Reserve, Monterey County, California (2nd ed). Envir. Field Program, University of California, Santa Cruz.
- Blanchard, A. 1979. New status for *Epiblema minutana* (Kearfott) and new species of *Epiblema* Hübner and *Sonia* Heinrich (Tortricidae). J. Lepid. Soc., 33: 179–188.
- Blanchard, A. 1984 (1985). *Epiblema luctuosana* A. Blanchard, a homonym, is changed to *Epiblema luctuosissima*, new name. J. Lepid. Soc., 38: 245.
- Bradley, J. D., W. G. Tremewan & A. Smith. 1973. British tortricoid moths. Cochylidae and Tortricidae: Tortricinae. Ray Society, London.
- Bradley, J. D., W. G. Tremewan & A. Smith. 1979. British tortricoid moths. Tortricidae: Olethreutinae. Ray Society, London.
- Danilevski, A. S. & V. I. Kuznetsov. 1968. Fauna of the U.S.S.R., Lepidoptera, Vol. 5(1), Tortricidae, Laspeyresiini. Akademiia Nauk SSSR, Leningrad.
- Horak, M. & R. L. Brown. (in press). Taxonomy and phylogeny. In van der Geest, L. P. S. (ed.). World crop pests, their biology, natural enemies and control. Elsevier Science, Amsterdam.
- Kornerup, A. & J. H. Wanscher. 1983. Methuen handbook of colour (3rd ed). Methuen and Co., London.
- Kuznetsov, V. I. 1978. Family Tortricidae. In Medvedev, G. S. (ed.). Keys to the insects of the European part of the USSR. Vol. 4, Lepidoptera, Part 1. Nauka Publ., Leningrad [1987. Translation for U.S. Dept. Agric. and NSF. Amerind Publ. Co., New Delhi. pp. 279–956].
- McFarland, N. 1965. The moths (macroheterocera) of a chaparral plant association in the Santa Monica Mountains of southern California. J. Research Lepid., 4: 43–74.
- Miller, W. E. 1985. Nearctic *Epiblema*: a new synonymy, a revised identity, and two new species (Lepidoptera: Tortricidae). Great Lakes Entomol., 18: 33–38.
- Miller, W. R. 1987. Guide to the olethreutine moths of Midland North America (Tortricidae). U.S. Dept. Agric., Forest Service Agric. Handbook, 660.
- Munz, P. A. 1959. A California flora. University of California Press, Berkeley.
- Nijhout, H. F. 1978. Wing pattern formation in Lepidoptera: a model. J. Exp. Zool., 206: 119–136.
- Nijhout, H. F. 1990. A comprehensive model for colour pattern formation in butterflies. Proc. R. Soc. London B, 239: 81–113.
- Obraztsov, N. S. 1965. On *Paedisca radicana* and the type species of the genus *Griselda* (Lepidoptera, Tortricidae, Olethreutinae). Amer. Mus. Novit., 2213: 1–16.
- Opler, P. A. & J. A. Buckett. 1970 (1971). Seasonal distribution of “macrolepidoptera” in Santa Clara County, California. J. Research Lepid., 9: 75–88.
- Powell, J. A. 1983. Tortricidae. pp. 31–41. In Hodges, R. W., et al. (eds.). Check list of the Lepidoptera of America north of Mexico. E. W. Classey Ltd., London, and Wedge Entomological Research Foundation, Washington, D.C.
- Süffert, F. 1929. Morphologische Erscheinungsgruppen in der Flügelzeichnung der Schmetterlinge, insbesondere die Querbindenzeichnung. Wilh. Roux' Arch., 120: 229–383.

Received 19 November 1990; accepted 7 January 1991.